



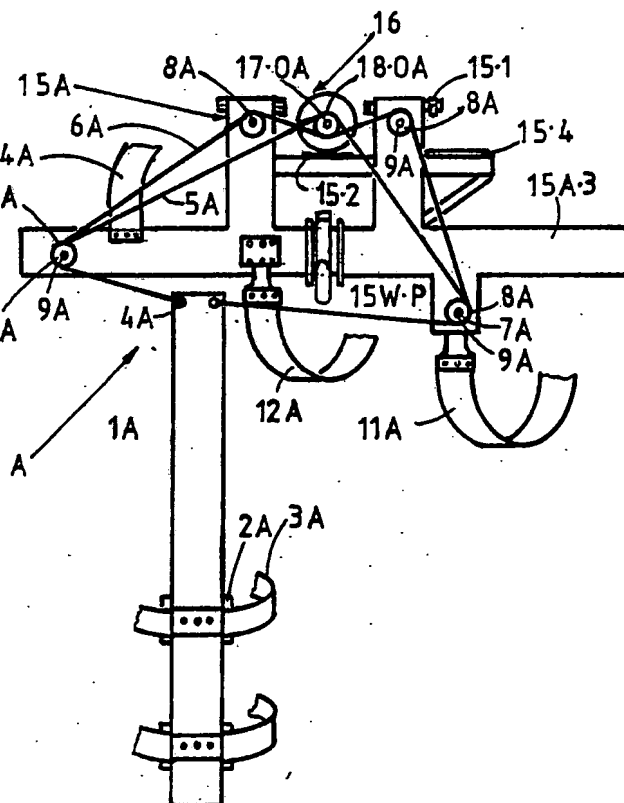
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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## (54) Title: VERSATILE PORTABLE ANIMAL ENERGY CONVERTOR

## (57) Abstract

A versatile animal-laden portable animal energy converting system for harnessing a portion of animal kinetic energy while the animal is grazing or travelling utilizing said portion for generating and storing electrical and/or mechanical energy on board of same animal whereinto said stored energy is collected, at intervals, for end-use wherever it is demanded in rural areas; so as to facilitate and modernize life there. In embodiment (A), prime movers (1A) each of which being fastened to a humerus or a thigh of an animal such as a camel, horse, cow, donkey etc. to convert the oscillational motion of said humerus or thigh, with driving belts (5A, 6A), pulleys (7A, 8A) and free-wheeled pulleys (17.OA, 18.OA), into rectified rotational motion to drive a device such as an electric generator (16) mounted on saddle (15A) which also includes a base (15.4) for a battery to store the generated electricity. In embodiment (B), no belts, pulleys or free-wheeled pulleys are used since each prime mover (1B) is directly in mesh with free-wheeled gears (Fig. 10)



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VERSATILE PORTABLE ANIMAL ENERGY CONVERTORFIELD OF THE INVENTION:

This invention relates to portable machines which are mounted on-board of animal for harnessing a portion of the animal movement, while the animal is grazing or travelling, to convert said portion into useable electric and/or mechanical energy.

BACKGROUND OF THE INVENTION:

Animal is well-known as a source of energy widely available for providing power for a variety of uses such as transportation, cultivation, lifting water from wells, rotatably driving grinding-mills and oil-mills and the like.

Billions of animals are available and globally distributed. If only a portion of the power of said enormous numbers of animals is effectively harnessed, it will provide a major contribution to other available sources of power.

Four disadvantages of animal power have been the cause of reducing its role in providing power for man use in comparison with the other sources of power. Said disadvantages are:

1. Restriction of the working animal within the working area during all the time of work. This means that the animal is restricted to work and being prevented from grazing as long as it is working; hence, a feeder is needed to be delivered to the animal after the work time to substitute the energy consumed in work and to provide it with its living needs. Delivered feeder is, in many cases, rather expensive.
2. A driver is usually needed to drive either a single animal or, in some cases, a couple of animals during the whole time of work except for transportation where a considerable number of animals, (a caravan), can be linked and hence be driven by a man or two. The cost of the driver, in most cases, is not less than the cost of the feeder mentioned above. Thus, the cost of power produced

by the animal has not been low.

3. In all applications, except for transportation, concentration of animal power to meet a relatively high power demand in a particular limited area has been impossible. That is because it has not been possible to connect a considerable number of animals all together to productively drive a single mill or machine or to pull a large plough or the like.

OBJECTS OF THE PRESENT INVENTION:

The principal objects of the present invention are :

1. To provide apparatus and means which overcome the above mentioned disadvantages so as to help animal to be able to play a considerably competitive major role in providing power for a wider variety of uses to the benefit of man-kind particularly in rural areas to help facilitate life there; more particularly the life of graziers who live in pastures or in grasslands whether they are villagers, semi-nomads or nomads peregrinating with their animals for pasturage. In other words, to help modernize and facilitate nomadism life.

Said modernization and facilitating of life in rural areas will, undoubtedly, increase the economical role of rural areas in the general economy of every country all over the world increasing the gross national product (GNP) of each country.

2. To provide such apparatus and means capable of contributing effectively in the current international campaign for reducing environmental pollution caused by the so called "the GREEN HOUSE EFFECT ". In other words, to help reduce the green house effect detriment.
3. To adapt rural areas for absorbing the jobless people who are nowadays living in large cities suffering from unemployment. This will also reduce the pressure on said cities caused by the increasing immigration of people from rural areas towards cities. In other words, to stop rural-to-city immigration and create a reverse immigration, city-to-rural.

4. Since food is the world's number one priority, it is a principal object of the present invention to provide apparatus and means capable of increasing food production activity in its wider sense.
5. To help solve the problem of land desertification via providing such apparatus and means capable of easing the widening of plantification activity in addition to eliminating the need for combusting plant matter (wood) in rural areas for cooking, heating, lighting and other uses;

Other objects and advantages of this invention will become apparent from the accompanying description taken in conjunction with the accompanying drawings wherein are set forth, by way of illustration and example, certain embodiments of this invention.

#### SUMMARY OF THE INVENTION:

The present invention provides an animal-powered energy system comprising portable apparatus and means for generating and storing electrical and/or mechanical energy on board of animal while the animal is grazing or travelling, utilizing a portion of the animal kinetic energy; wherein said stored energy be collected, at intervals, for end-use.

#### BRIEF DESCRIPTION OF THE DRAWINGS:

FIG.1 is a front view of an animal-powered motor-generator embodying a mien of the present invention.

FIG.2 is a perspective view showing how the contrary free wheels work.

FIG.3. is a sectional view of a contra-rotated electric generator with its relevant components.

FIG.4 is a side view of said generator.

FIG.5 is a side view of a saddle with a base on which the electric generator is installed.

FIG.6 is a perspective view of said saddle.

FIG. 7 is a perspective view of another embodiment of said saddle.

FIG. 8 is a free body diagram showing the movement range of prime mover 1A.

FIG. 9 is a descriptive view showing a camel with a prime mover 1A tied to its humerus.

FIG. 10 is a side view of prime mover 1B meshed to electric generator 16 in embodiment B.

FIG. 11 is a view of prime mover 1B.

FIG. 12 is a view of another shape of prime mover 1B.

DETAILED DESCRIPTION OF SOME PREFERRED EMBODIMENTS OF THE PRESENT INVENTION:

Before explaining the present invention in detail, it is to be understood that the present invention is not limited in its application or use to the details of construction and arrangement of parts illustrated in the accompanying drawings, because the present invention is capable of other embodiments, variations and modifications.

With reference to FIG. 1 of the drawings, there is shown a first embodiment A including a prime mover 1A which constitutes the first moving member of the system. Said prime mover 1A is very simple in shape and can be manufactured from simple materials such as wood or from other light strong composite materials such as resins, aluminium alloys or any reinforced light-weight materials.

Said prime mover 1A is simply connected to humerus (upper arm) or to thigh of an animal by belts 3A which are fitted to the lower half of said prime mover 1A. Small cushions 2A are mounted to the inside front of said prime mover in order to smooth the contact between the prime mover and the animal humerus or thigh; in other words, to prevent any undesirable pressure on the muscles of humerus or thigh of the animal when driving said prime mover. When connected to humerus or thigh of an animal, the prime mover moves with said humerus or thigh in an oscillational way as shown in FIGS. 8, 9 where the oscillator is the upper half (O-U) of the prime mover 1A; point O is the pivoting point around which the prime mover 1A pivots back and forth every time the animal moves its leg or thigh one complete step. Position of point O is exactly parallel to the shoulder joint or the hip

joint of the animal. Thus, the upper tip U, (FIG. 8 ), of the prime mover 1A keeps stroking between point F and point R (FIG. 8 ) as far as the animal is moving. When the animal stops, the upper tip U stops in mid way between said points F and R.

Belts 5A, 6A are unclosed belts with metal rings fixed to either ends of each belt.

Four pivots 4A are mounted to the two faces of the upper end of prime mover 1A, two to each face, to provide pivots around which the said metal rings pivot to ease the intermovement between the belts ends and the prime mover 1A. When prime mover 1A oscillates, belts 5A, 6A are tensioned back and forth transferring the oscillational movement of prime mover 1A into rotational movement through free-wheeled pullies 17.OA, 18.OA, as will be described later in the next paragraph, to drive either an electric generator 16 or an air compressor or to drive any small desirable device.

Free-wheeled pullies 17.OA, 18.OA are small free wheels with grooved circumferences, for this embodiment A, while they are toothed for other embodiments such as embodiment B where no driving belt is used. Each free-wheeled pulley functions as a rectifier to rectify the back and forth movement of a driving belt 5A or 6A into one direction rotational movement exerted on the driving shaft of the generator or compressor or any device. Two contrarotatable free-wheeled pullies are mounted to a drive shaft. This is done simply by contrary contact between belts 5A, 6A and pullies 17.OA, 18.OA such that said belts contrarily contact said pullies as shown in FIG. 2. Hence, when the two belts 5A, 6A are tensioned to the left, pulley 18.OA clockwise rotates the driving shaft while pulley 17.OA is freely rotating anticlockwise around said shaft allowing said shaft to be rotated under action of pulley 18.OA only. When said belts 5A, 6A are tensioned to the

right, pulley 17.OA clockwise rotates said shaft while pulley 18.OA is freely rotating anticlockwise around said shaft allowing said shaft to be rotated, this time, under action of pulley 17.OA only. Frequent oscillation of prime mover 1A provides the torque needed to accelerate the electric generator 16 or any other small device.

Generated electricity is directly stored in light-weight batteries which have high gravimetric energy density (high capacity to weight ratio).

Fortunately, the recently achieved advancement in the field of plastics that conduct electricity provides not only light weight batteries, but also polymer wires for winding generators and for connection lines from generator to regulator to battery.

For instance, the Bridgestone Corporation and Seiko Electronics Parts jointly developed a rechargeable battery with a polyaniline electrode that went on sale in Japan two years ago. The other electrode is made of lithium metal which is also very light. These batteries are said to have a capacity three times that of existing rechargeable lithium batteries of the same type and a voltage two to three times as high as nickel-cadmium batteries.

B.A.S.F.A.G, in West Germany, announced -two years ago - that by doping a very pure form of polyacetylene they had produced a material with twice the conductivity of copper by weight.

B.A.S.F. also developed a thin flexible rechargeable battery with plastic-metal electrodes which can save space and offer design freedom.

Hence, the present invention provides further applications to the conducting polymers and to polymer batteries.

Thus, the weight of generator and batteries needed for a single system of the present invention is low as well as the whole system is made of very light weight materials available in markets.

Stored electricity is collected every night to be either used for lighting or for operating devices such as



fans, heaters, stoves, microwave ovens, dehumidifiers, air-conditioning devices, refrigerators etc. ,as will be explained later within " Examples on its Applications" ; in case of stored compressed air, it is also collected every night to be either used or stored until it is needed.

Saddle 15A shown in FIGS.1,5,6 comprises the structural base of the system;most components and parts of the system are mounted to said saddle. Hings 15.1,in top of said saddle,provide flexibility for both suiting the size of back of animal and easing the resaddling-unsaddling of the system . The side beam 15A.3 on either side of the saddle is for providing fastening points for fastening belts 11A,12A,14A and two axles 9A are mounted to it with a pair of pullies 7A,8A around each axle to provide normal reaction in asuitable angle for belt 5A to drive free-wheeled pully 17.OA and for belt 6A to drive the two pullies 7A near the top of saddle providing ,in turn,reaction for belt 6A to drive free-wheeled pully 18.OA in the oposite direction to the other free-wheeled pully 17.OA.

Needless to say that some kind of cushions or cloth should be fitted to the inner sides of the saddle or be put on back of animal to smooth the contact between said saddle and the animal body.

On top of saddle 15A is the base 15.2 on which is mounted the desired device to be operated . A variety of devices can be operated alternatively;and even two different devices can be mounted on base 15.2,back to back,to be operated simultaneously by two prime movers 1A,in parallel planes, one from each side of the animal; for example, an air compressor on one side and an electric generator on the other side. Furthermore, another couple of devices can be similarly operated by another couple of prime movers 1A or 1B tied to the same animal thighs if the first couple of prime movers is tied to the animal humeruses; another base 15.2 can be installed somewhere as an addition to the saddle . More examples on versatility of the present invention will be described later within "Examples on its Applications" .

Although two conventional electric generators can be mounted back to back on base 15.2 to be separately operated by two prime movers 1A, a better choice is a single contra-rotated electric generator 16CON., shown in FIG.3, whose rotor 16.1 and "stator" 16.2 have two concentric shafts 16.3, 16.4 contrarily rotatable by two prime movers 1A tied to humeruses of a single animal where the two prime movers 1A oscillate in parallel planes with two belts 5A, 6A connected to each prime mover 1A and contact the free-wheeled pulleys 17.0A, 18.0A in the same way as mentioned above and shown in FIG.2, but -in this case- from either side of the generator; (keeping but repeating the same arrangement as in the case of a conventional generator 16, from either side,). In other words, as if two separate generators had been mounted back to back on the same base 15.2.

Rotation of shafts 16.3, 16.4 of rotor 16.1, "stator" 16.2 is contrary without any need for gearing; because each side of the generator 16CON. is looked at from one side of the animal and is driven by a prime mover 1A tied in the same side of animal; thus, clockwise rotation of the "stator" 16.2 at left side of the animal is opposite to clockwise rotation of the rotor 16.1 at right side of the animal.

construction of the contra-rotation electric generator 16CON. is as shown in FIG.3 where the housing 19 of said generator comprises: base 19.0 for fixing the whole generator to base 15.2 on saddle 15A by bolts 19.3; two hollow bosses 19.1, 19.4 to house two bearings 16.6 for the inner shaft 16.3 (shaft of rotor 16.1); two holes 19.5 to house two bearings 16.5 for the outer shaft 16.4 (shaft of "stator" 16.2); a number of holes 19.8 to fit together (fasten) the two halves of the housing 19 after installation of the generator with its bearings; handling bar 19.2 for facilitating the task of loading-unloading of the system and to provide perfect tightness to the housing 19.

A couple of free-wheeled pulleys 17.0A, 18.0A is mounted to shaft 16.3 while another couple with suitable diameter is mounted to shaft 16.4 at the other side of the

generator.

Size and weight of the generator and/or the whole system, for a given rated power, is apparently necessary to be as small and light as possible. However, factor of size is less important than factor of weight; hence, lightweight high-strength equipment is preferably used in construction of it although it can be built from conventional ordinary cheap materials but on account of productivity.

Available technology provides a wide range of lightweight high-strength materials for this purpose.

Examples on that are:

- titanium is more suitable for pullies(7A,8A), axles 9A, shafts (16.3,16.4) and the like; (titanium axles have been used for modern bobsled and other devices.);
- laminated plastics(composites) are another choice for pullies 7A,8A and free-wheeled pullies(17.0A,18.0A), bearings and the like;
- carbon fiber, fiberglass composite, fiber reinforced plastics(such as: glass fiber reinforced plastics(G.R.P.) ), resins(such as: epoxides, unsaturated polysters) and the like are good for prime mover 1A, saddle 15A and the like;
- magnequench magnets(produced by General Motors, America), are suitable for electric generator 16 or 16CON., as said magnets are strong, light and inexpensive compared with rare material magnets;
- doped polyacetylene plastic wires(produced by B.A.S.F. in Germany) can replace copper wires for winding of electric generator 16 or 16CON and for connection lines from generator to regulator to battery;
- polymer-lithium rechargeable batteries(produced by Bridgeston & Seiko in Japan and those produced by other companies in other countries) are ideal as they are very light, have both very high capacity and relatively high voltage, have long life and do not contain toxic materials;
- aluminium alloys provide good materials for a wide range of the above mentioned components as well as for air compressors, air tanks etc.

SIZES OF THE SYSTEM:

Since the system is intended to be essentially powered by animal and since different kinds of suitable animals are available, the system size is governed by the following factors:

1. Kind of animal, ( camel, cow, horse, mule, hinny, donkey, goat, sheep, dog). To suit kind of animal, sizes fall into three categories:

- category a, for camel;
- category b, for: cow, horse, mule, hinny and donkey;
- category c, for: sheep, goat, dog and the like.

2. Age or size of animal: every category have three sizes: small, medium, large to suit three approximative ages of that kind of animal.

Sizes are classified or identified by category symbol a, b or c plus rated weight of such system.

Weight is, of course a very important limiting factor since every animal has a maximum limit of capability to carry loads. Nevertheless, many kinds of widely available animals have considerable maximum limits. For instance, an adult camel can carry a maximum load of three hundred kilograms (300 kg.) for tens of kilometres of distance; adult camel average load is 200 kg.; adult horse average load is about 130 kg.; adult cow, mule, hinny or donkey average load is approximately the same as adult horse average load; adult sheep, goat, dog or the like average ability to carry loads is 20 kg.

Since the present invention is directed to harnessing only a portion of each animal available power, the system weight should not and need not exceed one third of the animal maximum load. A reasonable weight of a system is one third of average load of the animal for which the system is designed. Yet, a system of 45 kg. weight is sufficient for an adult camel system; 30 kg. for an adult horse, cow, mule, hinny, or donkey system; 5 kg. for an adult sheep, goat or dog system. Table 1 shows suitable system weights for different categories.

TABLE I  
System Weight for Different categories

| Kind of animal                       | Categ-<br>ory | Age of<br>animal | Average<br>load of<br>animal<br>kg.                | Suitable<br>system<br>weight<br>kg. | Size<br>classif-<br>ication |
|--------------------------------------|---------------|------------------|--|-------------------------------------|-----------------------------|
| Camel                                | a             | Adult            | 200  | 45                                  | a45                         |
| Camel                                | a             | Medium<br>aged   | 130  | 30                                  | a30                         |
| Camel                                | a             | Young            | 80   | 20                                  | a20                         |
| Horse, cow, mule,<br>hinny or donkey | b             | Adult            | 130  | 30                                  | b30                         |
| Horse, cow, mule,<br>hinny or donkey | b             | Medium<br>aged   | 80   | 20                                  | b20                         |
| Horse, cow, mule,<br>hinny or donkey | b             | Young            | 40   | 10                                  | b10                         |
|                                      |               |                  | Average<br>capabil-<br>ity of<br>carrying<br>(kg.) |                                     |                             |
| Sheep, goat, dog<br>or the like      | c             | Adult            | 20   | 5                                   | c5                          |

Yet, system sizes are not restricted to the limits shown in table 1. There is much flexibility in this matter as far as a system weight is less than the average load of the animal for which the system is designed.

A typical system size is a45 which is for an adult camel. Distribution of weight of said size on its components is shown in table 2 for only giving an example since it can be distributed in any proportion according to the kind of material from which each component is made.

TABLE 2

Distribution of weight of a typical system

| Main component   | Weight<br>kg. |
|--|---------------|
| Two prime movers 1A, 2.5 kg. each.   | 5             |
| Saddle 15A with its fittings + pivots + pulleys + side beams.                    | 15            |
| Contra-rotated electric generator 16CON. + free wheeled pulleys + driving belts. | 12            |
| Voltage regulator + connection wires from generator to regulator to battery.     | 2             |
| Battery + its fittings.  | 11            |
| Total weight   | 45            |

Rated power of each size is governed by kind of materials from which the system is made. Light-weight materials allow higher rated power for a system of a given weight. Systems whose weights are as shown in table 1 and are made from relatively inexpensive relatively widely available relatively light-weight materials are assumed to have rated power for each size as shown in table 3.

TABLE 3

| Kind of animal                    | Weight<br>of<br>system | Size classification | Rated<br>power.<br>Watts |
|-----------------------------------|------------------------|---------------------|--------------------------|
| Camel.                            | 45                     | a45                 | 200                      |
| Camel.                            | 30                     | a30                 | 120                      |
| Camel.                            | 20                     | a20                 | 65                       |
| Horse, cow, mule, hinny or donkey | 30                     | b30                 | 130                      |
| Horse, cow, mule, hinny or donkey | 20                     | b20                 | 80                       |
| Horse, cow, mule, hinny or donkey | 10                     | b10                 | 40                       |
| Sheep, goat, dog or the like.     | 5                      | c5                  | 20                       |

Embodiment B has the same principles as embodiment

A but no driving belts or pullies are used. Instead, the driven device(generator 16, contra-rotated generator 16CON., or air compressor etc.) is directly driven by toothed prime mover 1B which is kept in mesh with free-wheeled bevel gears 17.OB, 18.OB as shown in FIG.8. Upper part of prime mover 1B is made curved; either part-circular as shown in FIG.9(a) or semi-circular as in FIG.9(b). In case of using a part-circular prime mover 1B, the base 15.2 on which the operated device is mounted is positioned somewhere over neck of animal as shown in FIG.6(b) while some other components of the system are positioned on rear back of animal to achieve balance of weights. In case of using a semi-circular prime mover 1B, said base 15.2 is mounted at a relatively high position just on vertical centerlines of animal humeruses and in this case the lower part of prime mover 1B is longer than it is in the other shape; this extension is necessary for only this shape of prime mover in order to prevent collision between it and the ground when the animal kneels down; in other words, to keep providing full freedom to the animal to kneel down whenever it wants or is wanted to kneel down. NO extension is needed for the other shapes of prime movers 1A, 1B as their upper parts design allow free kneeling down.

Some animals tend to wallow, that is to roll or welter; this is a natural tendency; so, the design of the system include side wallowing preventers 15.W.P mounted to side beams as shown in FIG. 7 in a suitable position which does not interfere with the movement of prime mover or belts. When the animal tries to wallow, normal reaction of the ground is exerted on said wallowing preventers and is transmitted to the animal body side causing some pressure on a small area of the animal body to the extent that the animal dislikes this kind of pressure (although it not harmful) and hence changes its mind and dislikes to roll or welter as far as the system is on its back.

A small voltage regulator (not shown) is mounted to the saddle at any chosen position and be connected to

both the generator 16 or 16CON. and the battery by wires (not shown).

Battery (not shown) can be either a single case unit or two batteries connected together in series or in parallel (as desired) and are fitted with suitable fittings to battery base 15.4 on saddle 15A or 15B. however, there is much freedom in choosing the position for said battery base 15.4 .

For end-use, electricity can either be used as direct current(D.C.) for DC appliances or be inverted into alternating current(A.C.) by using a suitable inverter. There is a wide variety of invertors in different sizes and types available in markets (such as those used for solar and/or wind energy conversion systems); even a very small type of inverter is available for operating a single fluorescent lamp of 20 watts, for camping.

compressed air can be used for driving small turbines to provide end-use mechanical power or to drive small generators. Furthermore, compressed air can be used for operating vortex tube devices for airconditioning or space heating, since said vortex tubes are very compact, effective, simply controlled; a single vortex tube can be operated as an airconditioner and simply be converted into a space heating device by just adjusting a valve.

Concentration of power, particularly electric power, to meet a given power demand is simply carried out by connecting several batteries together either in series to provide high voltage or in parallel to provide high current capacity.

A group of batteries (battery bank) can be loaded on a single animal such as a camel to provide portable power in any desired site. Several camels carrying several battery banks can be linked tail-to-nose (a caravan) to meet any power demand at any site whatever its topography is.

With the use of polymer-lithium batteries, a single adult camel can carry a package of batteries (battery bank) of approximately 5000 ampere.hour(a.h.) capacity, 12V. D.C.;



which, by using an inverter, can be converted into 220 V., (A.C.) at an efficiency of  $\pm 90\%$  to provide approximately 54 kilowatt-hour(k.w.h.)of electric energy; enough energy to meet a power demand of 6.75 kw. for a continuous work time of 8 hours.

A series of as many as a hundred camels carrying battery banks can be linked and then be driven by a single man or two providing as much energy as 5400 kilowatt-hours; enough portable power to meet a demand of 675 kw.,for a continuous worktime of 8 hours, for agriculture activity, pasturage activity, reforestation activity or any industry which require portable power.

Needless to say that all battery banks of the said caravan can be combined to form a united battery bank which needs only few large size invertors carried on board of other camels. Said combination is simply implemented by wires passing aside or being stucked down,with a Scotch tape,to the nose-band of each camel from a battery bank on board of a camel to the next battery bank on board of the next camel and so on.

#### EXAMPLES ON ITS APPLICATIONS:

Billions of animals are globally available and hundreds of millions of jobless people are globally causing rapid urbanization problems. The most important reasons for urbanization trends are:

1. Availability of services and amenities is deemed in urban areas.
2. Availability of electricity which is an indicator of housing standards;it not only provides the source of power for domestic lighting but also indicate access to many aspects of modern living,such as the use of appliances.

To stabilize rural population,minimize urbanization trends and even create urban-to-rural migration are international goals. To achieve said international goals,the gap between level of life in rural areas and level of life in urban areas should be narrowed as far as possible.

The key to this narrowing of said gap is the availability of electricity everywhere in rural areas.

Rural households are spread over large areas and the provision of electricity to them through central power plants is very difficult and costly; even in case of using solar or wind power for remote sites; furthermore, great numbers of rural households are nomadic or semi-nomadic who peregrinate with their animals for pasturage.

So, the present invention provides an ideal and perfect means to provide them with their power requirements, especially electric power which they need for many purposes among which are the following applications:

1. Lighting; 2. Space heating; 3. Airconditioning; 4. cooking; 5. Water heating; 6. Powering television (T.V.) sets, radio receivers cassette recorders and other entertainment or education devices; 7. Powering communication devices such as aerial telephones etc.; 8. Providing cathode protection for pipelines and other installations in desert remote areas;
9. Powering refrigerators (either thermoelectric refrigerators--since they utilize DC current, are very light in weight, compact, non-polluting since they need no refrigerant, and can be operated even on board of animal such as camel while it is travelling;--or conventional refrigerators.).

Refrigeration is obviously vital for keeping milk and its products fresh until they are either consumed at the same site or sold fresh in a relatively near market to which they can be sent in thermoelectric refrigerators powered by batteries carried with them on board of animals. On return, said refrigerators may contain some fruits or the like from the market to the rural remote site such as a pasture or a very small village;

10. Powering immersed water pumps for pumping water from lakes, rivers, shallow water wells or even deep water wells for varied uses including irrigation, livestock water needs and man-kind uses. A wide variety of compact light-weight immersed pumps is available in markets and they are ideal

for peregrinating people since said pumps can be easily carried with their light-weight hose-pipes on board of animal and be powered electrically with a battery or battery bank carried also on board of animal (thus, eliminating either the need for fixed large pumping facilities on water points or the hard work of manually lifting the needed water)

11. Powering portable devices for saline water desalination. there is a wide variety of desalination devices in small portable sizes suitable for small demands of soft water in desert and/or coastal areas; power is required to operate any of them. Reverse osmosis process, electrodialysis method and Hickman centrifugal force compression water distiller are the most suitable for portable uses; all of them require electric current. Hickman centrifugal device offers the advantages of (a): capability of being a dual-purpose device; since it can be also used for both sterilizing and concentrating milk for providing evaporated sterilized milk in order to reduce the volume and weight of milk which is intended to be carried on board of animals to markets for sale. (Thus, a single small size Hickman distiller will be enough for water desalination and milk concentration-sterilization.); (b): no membranes are required for them; hence, importation of membranes is eliminated;

12. Powering portable electric-powered milking machines to ease milking operations;

13. Powering Perrin portable sterilisation units for home dialysis;

14. Powering portable electric-powered shearing machines to clip wool, fluff or hair;

15. Powering portable electric-powered spinning machines to spin wool and the like;

16. Powering portable light-weight electric-powered weaving machines to weave wool and the like for cloth and/or tent uses;

17. Powering portable electric-powered sewing machines to sew cloths, tents and the like;

18. Powering portable light-weight hand-handled electric-powered sickles or scythes;

19. Powering portable small size electric-powered chipper/shredder machines to turn organic throwaways into useful wood chip mulch and compost materials or for manufacturing special diets for animal feed;

20. Powering portable light-weight electric-powered hand-handled tillers for small size agriculture activities.

CLAIMS

I claim:

1. A versatile animal-laden portable animal energy converting system comprising:

- (a) animal-powered prime movers each of which being fastenable to either a humerus or a thigh of an animal for utilizing its movement for providing oscillational movement of upper tip of each prime mover so as to rotationally drive an electric generator, an air compressor or a chosen device mounted on a saddle on board of said animal;
- (b) transmission means for transferring said oscillational motion into said rotational driving via driving belts and/or gears a portion of which being fitted to the upper tip of each said prime mover;
- (c) a saddle on which and to which all the remaining components of said system are mounted;
- (d) a contra-rotated electric generator operatable by a couple of said prime movers acting in parallel planes, one in each side of a single animal;
- (e) an energy storage device such as a battery carried on board of same animal to store electricity generated on board of same animal or, alternatively, a small compressed air tank carried in same manner to store compressed air compressed by an air compressor powered in same manner on board of same animal.

2. A versatile animal-laden portable animal energy converting system according to claim 1, wherein each said prime mover is alternatively:

(A): a simple-shaped rectangular bar having:

- (a) four small pivots mounted to its upper tip for providing pivots for metal rings each of which comprises an end of an unclosed driving belt;
- (b) fastening belts fitted to its lower half for fastening said prime mover to a humerus or a thigh of an animal;
- (c) small cushions mounted to the inside front of said lower half of said prime mover for convenience of animal body; or

(B): a tip-teethed prime mover the lower half of which being the same as the lower half of said simple-shaped rectangular bar, and having similar fastening belts, cushions while the upper half of it is:

- (a) curved in shape, e.g.; part-circular, semi-circular etc.;
- (b) its curved tip is teethed in a way which provides two alternate parallel "curved racks" 5B, 6B between whom a space is provided for two concentric vertically opposite free-wheeled bevel gears 17.0B, 18.0B which comprise the pinions (followers) of said "curved racks" which have a module, addendum, dedendum, pitch-cone apex and tooth thickness similar to those of said free-wheeled bevel gears.

3. A versatile animal-laden portable animal energy converting system according to claim 1, wherein said saddle is characterized in that it includes:

- (a) two side beams to each of which a pair of pivots is mounted to provide pivots for pullies 7A, 8A;
- (b) two other pairs of pivots each of which is mounted to each upper side of said saddle to provide pivots for other pullies;
- (c) a base on which a generator, an air compressor or a similar device can be mounted;
- (d) a base on which a battery, a compressed air tank or the like can be mounted;
- (e) wallowing preventers mounted to each said side beam.

4. The arrangement of each couple of free-wheeled pullies with each couple of unclosed belts, whereby the driving shaft, to which said couple of free-wheeled pullies is mounted, is rotated in one direction although the said couple of belts is frequently tensioned back and forth.

5. The arrangement of each couple of free-wheeled gears with each teethed prime mover, whereby the driving shaft, to which said couple of free-wheeled gears is mounted, is rotated in one direction although the teethed prime mover is in oscillational motion.

## AMENDED CLAIMS

[received by the International Bureau  
on 20 May 1991 (20.05.91);  
original claim 1 amended;  
new claim 6 added; other claims unchanged (3 pages)]

I claim:

1. A versatile animal-laden portable animal energy converting system including:

- (a) a contra-rotated electric generator and/or a small air compressor;
- (b) belts, pulleys and gears comprising a portion of transmission means;
- (c) an energy storage device such as a battery carried on board of same animal to store electricity generated on board of same animal or, alternatively, a small compressed air tank carried in same manner to store compressed air;

said energy converting system being characterised in that in addition to its capability of being independantly operated on board of animal while same animal is freely grazing or travelling, it is also characterised in that in order to utilize oscillational movement of humerus and/or thigh of animal to produce and store electric or mechanical energy on board of same animal it includes:

- (d) animal-powered prime movers each of which being fastenable to either a humerus or a thigh of an animal for utilizing its movement for providing oscillational movement of upper tip of each prime mover so as to rotationally drive an electric generator, an air compressor or a chosen device mounted on a saddle on board of same animal;
- (e) a saddle on which and to which all the remaining components of said system are mounted as well as a wallowing preventer mounted to either side of it.

2. A versatile animal-laden portable animal energy converting system according to claim 1, wherein each said prime mover is alternatively:

- (A): a simple-shaped rectangular bar having:
  - (a) four small pivots mounted to its upper tip for providing pivots for metal rings each of which comprises an end of an unclosed driving belt;
  - (b) fastening belts fitted to its lower half for fastening said prime mover to a humerus or a thigh of an animal;

- (c) small cushions mounted to the inside front of said lower half of said prime mover for convenience of animal body; or
- (B): a tip-teethed prime mover the lower half of which being the same as the lower half of said simple-shaped rectangular bar, and having similar fastening belts, cushions while the upper half of it is:
  - (a) curved in shape, e.g. part-circular, semi-circular etc.;
  - (b) its curved tip is teethed in a way which provides two alternate parallel "curved racks" 5B, 6B between which a space is provided for to concentric vertically opposite free-wheeled bevel gears 17.OB, 18.OB which comprise the pinions (followers) of said "curved racks" which have a module, addendum, dedendum, pitch-cone apex and tooth thickness similar to those of said free-wheeled bevel gears.

3. A versatile animal-laden portable animal energy converting system according to claim 1, wherein said saddle is characterized in that it includes:

- (a) two side beams to each of which a pair of pivots is mounted to provide pivots for pulleys 7A, 8A;
- (b) two other pairs of pivots each of which is mounted to each upper side of said saddle to provide pivots for other pulleys;
- (c) a base on which a generator, an air compressor or a similar device can be mounted;
- (d) a base on which a battery, a compressed air tank or the like can be mounted;
- (e) wallowing preventers mounted to each said side beam.

4. The arrangement of each couple of free-wheeled pulleys with each couple of unclosed belts, whereby the driving shaft, to which said couple of free-wheeled pulleys is mounted, is rotated in one direction although the said couple of belts is frequently tensioned back and forth.

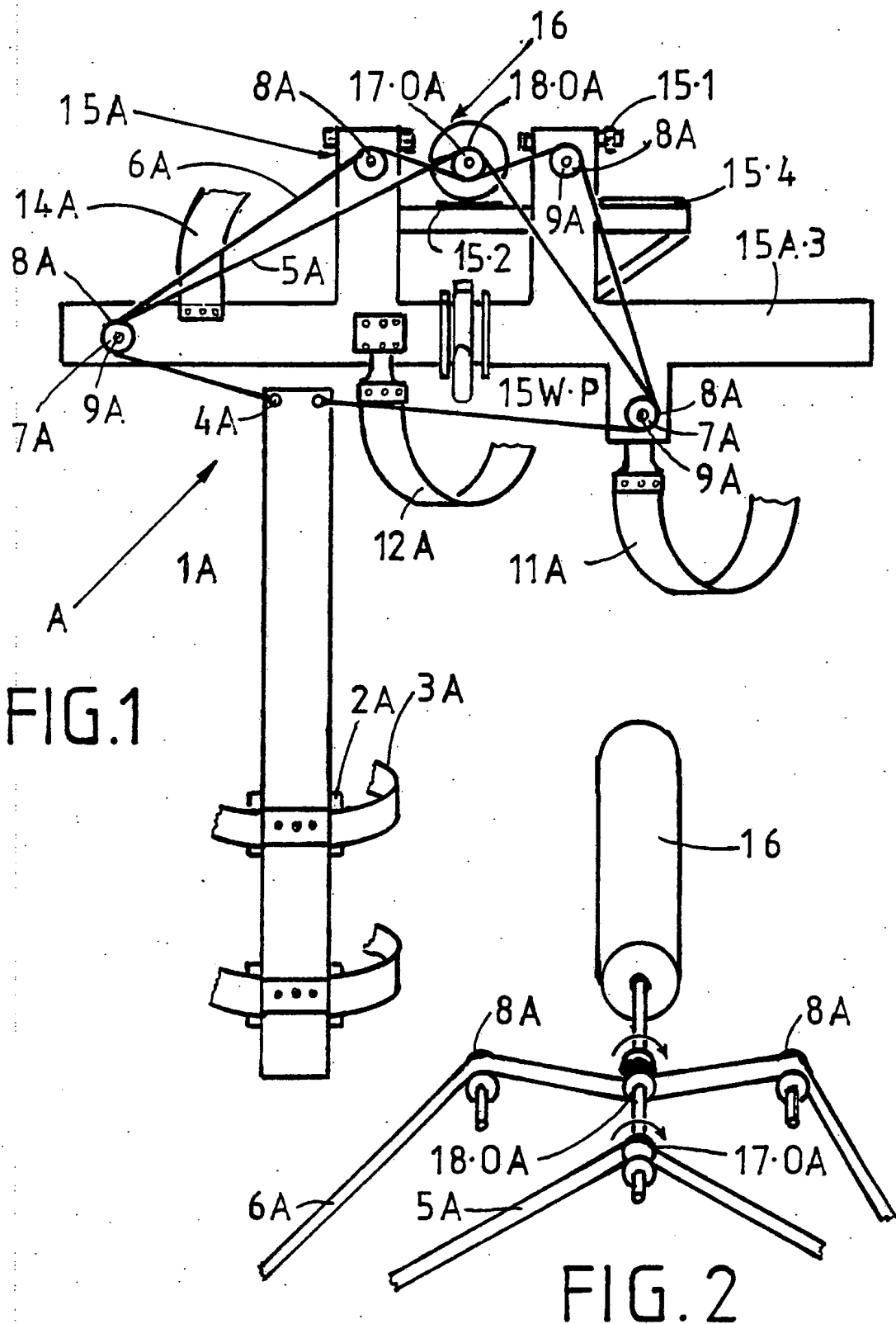
5. The arrangement of each couple of free-wheeled

gears with each teathed prime mover,whereby the driving shaft,to which said couple of free-wheeled gears is mounted,is rotated in one direction although the teathed prime mover is in oscillational motion.

6. A versatile animal-laden portable animal energy converting system according to claims 1 and 3,wherin each said wallowing preventer,mounted to each side beam of said saddle,is a means of transmitting some ground normal reaction to some small area of animal body side to prevent it from wallowing as far as the system is laden on its board.



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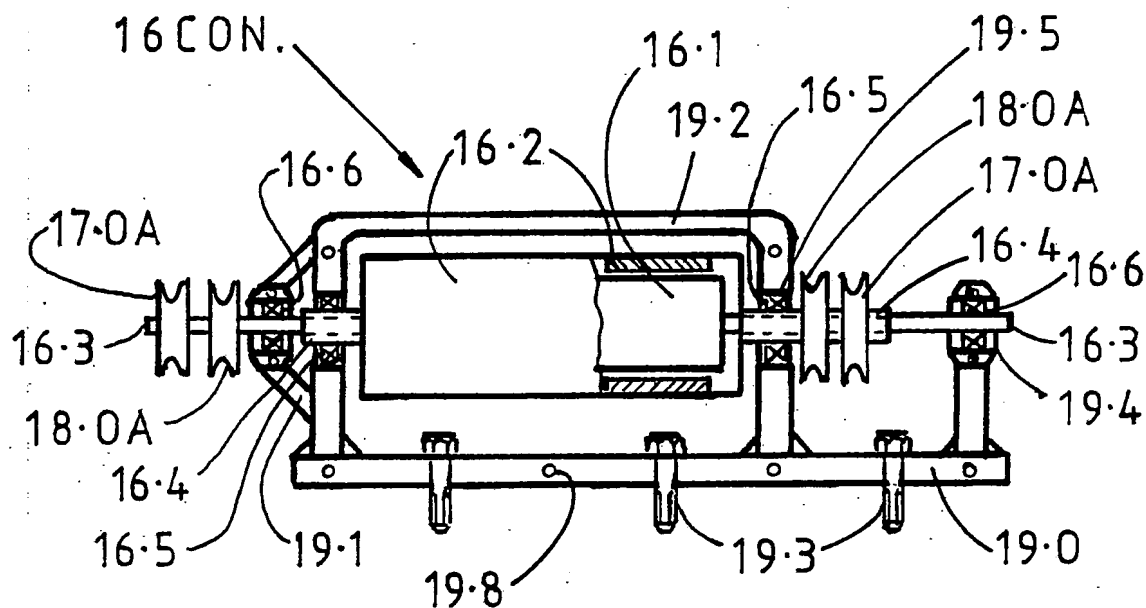


FIG. 3

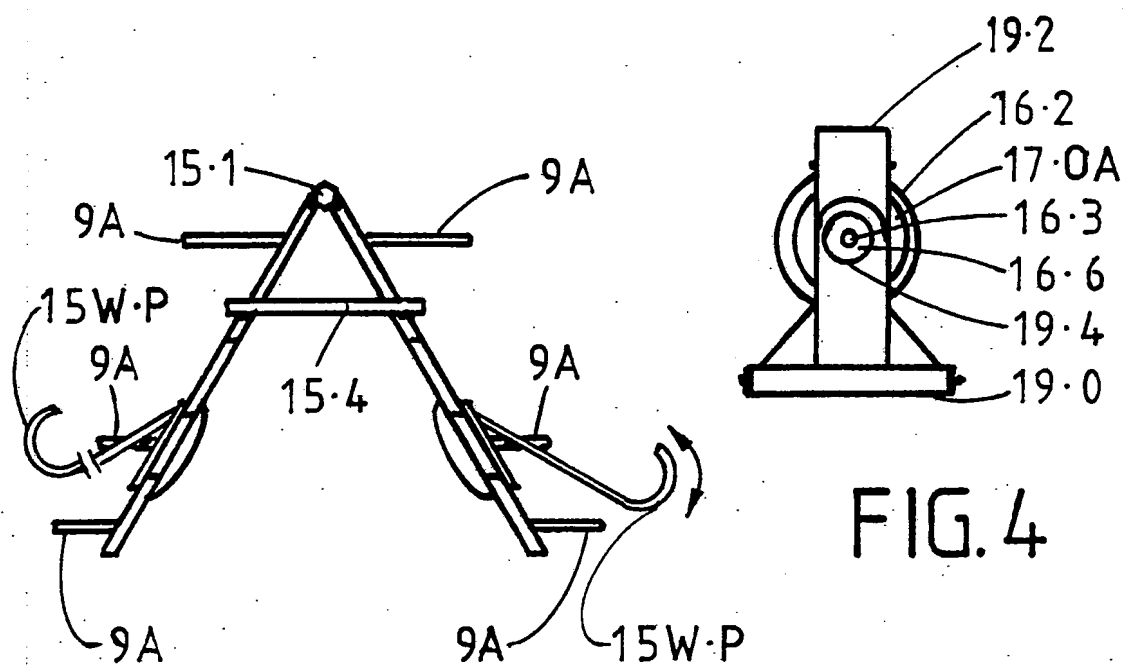


FIG. 4

FIG. 5

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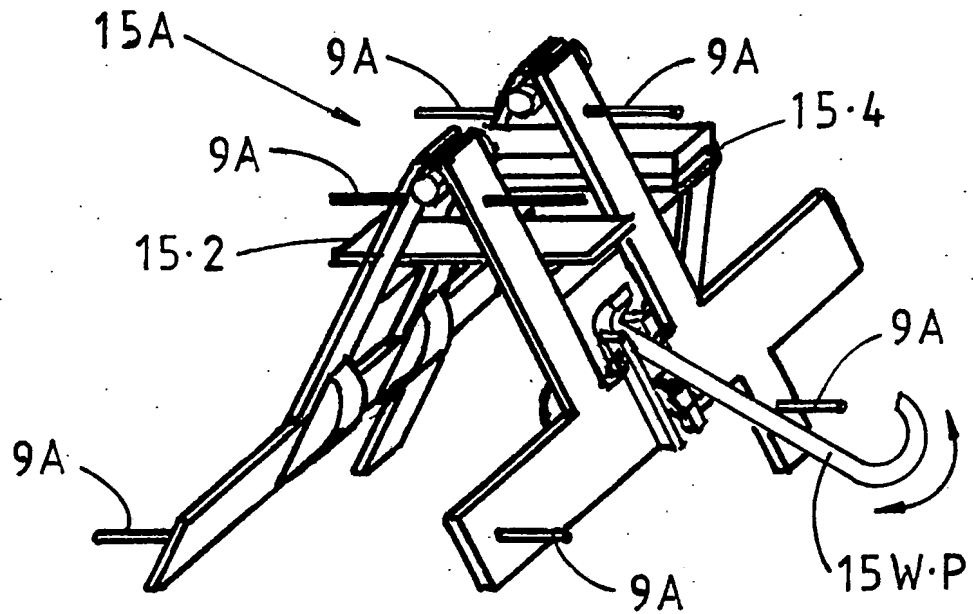


FIG. 6

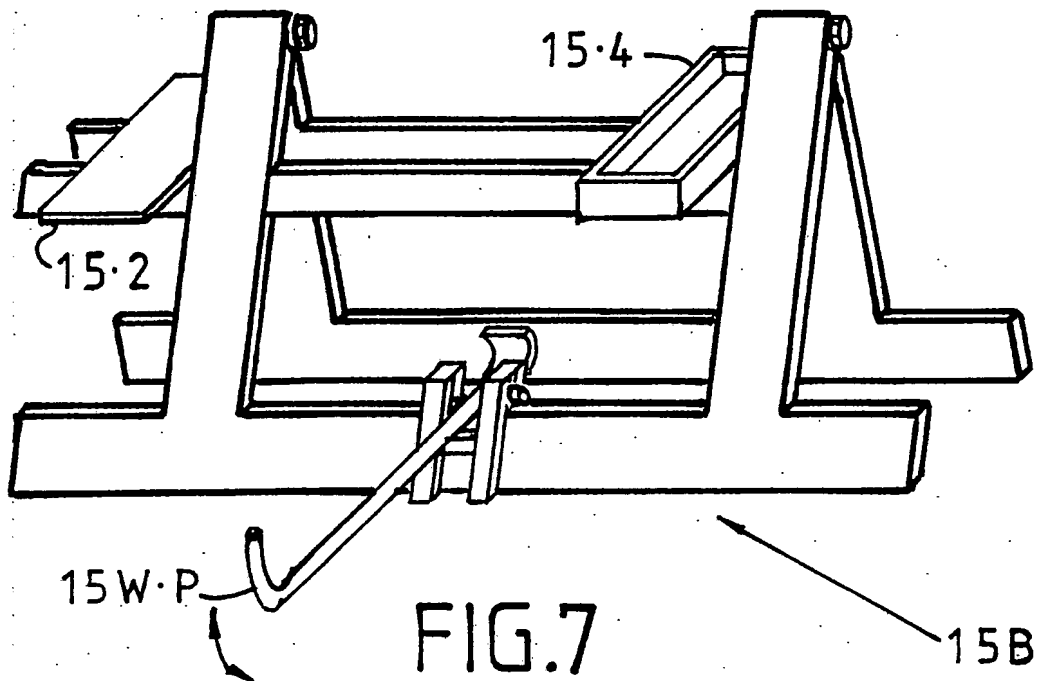


FIG. 7

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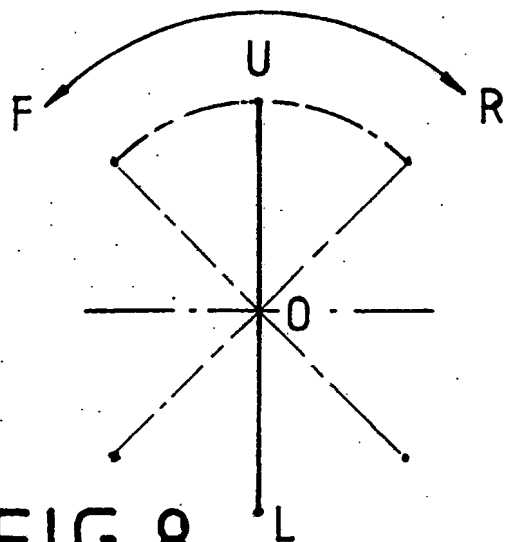


FIG. 8

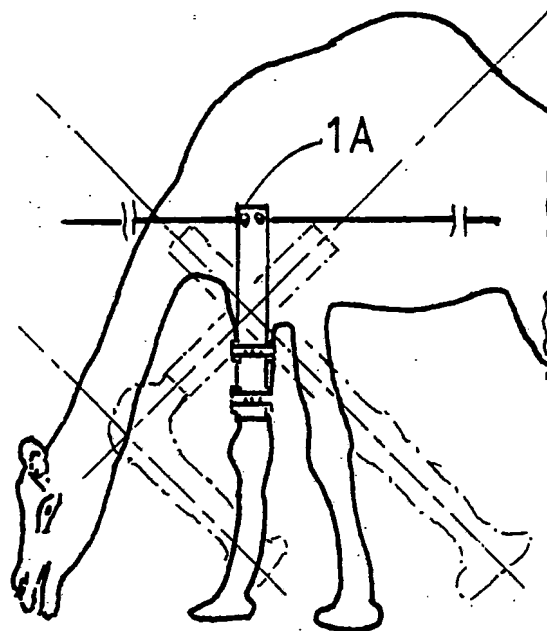


FIG. 9

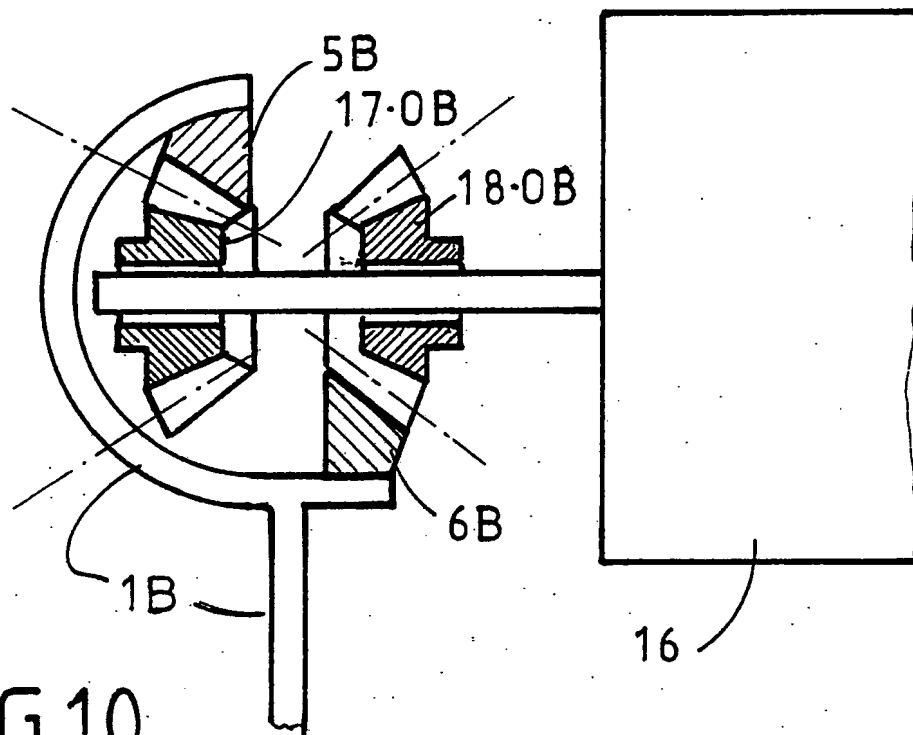


FIG. 10

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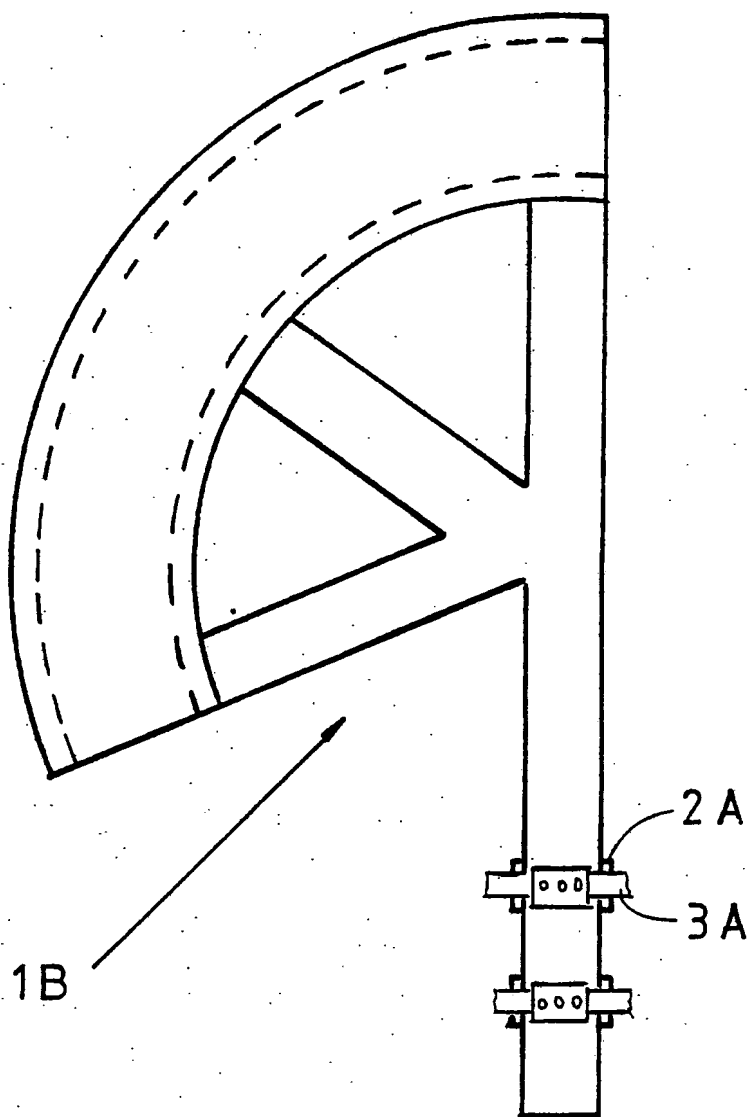
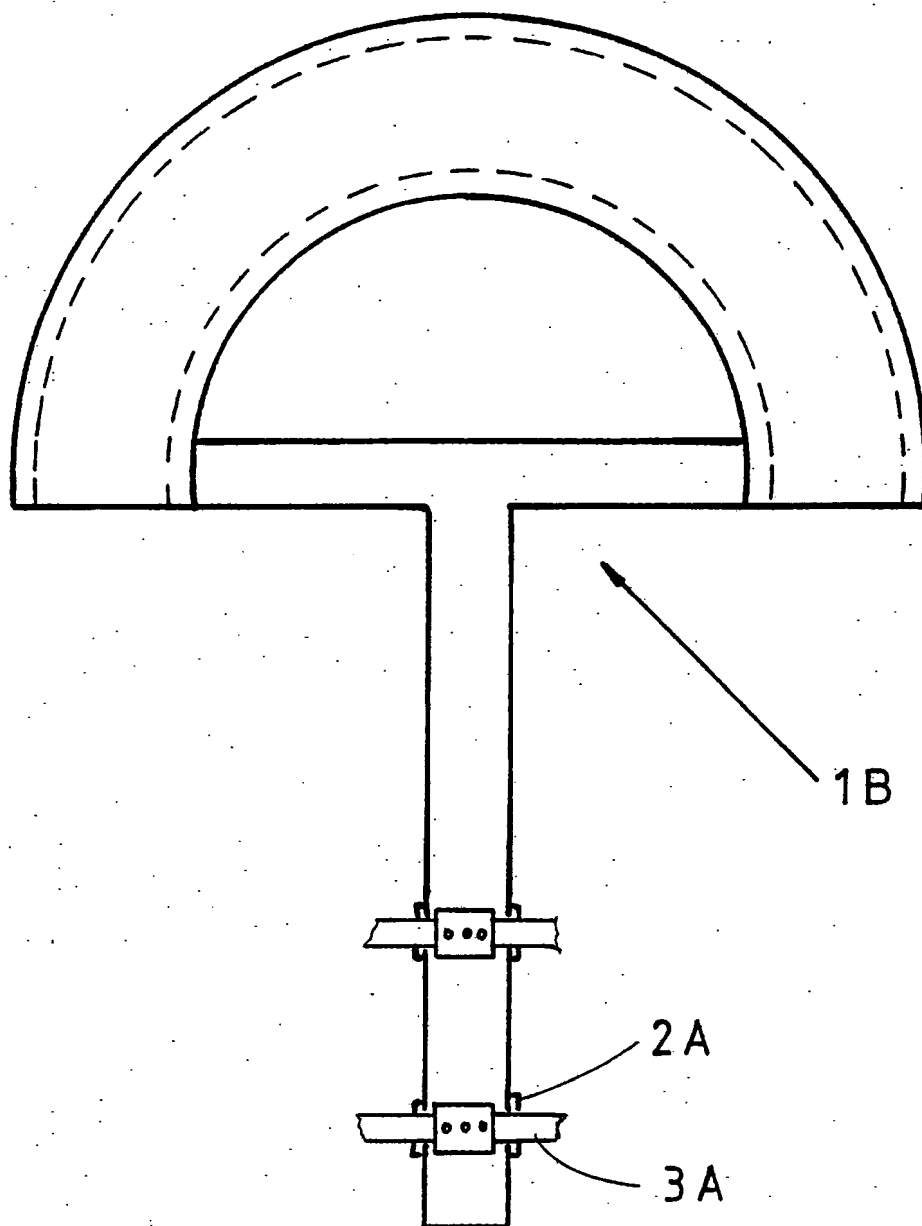


FIG.11

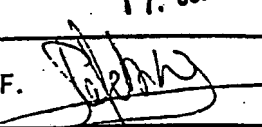
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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/OA 89/00001

|  |  |                                     |
|--|--|-------------------------------------|
| <b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) <sup>6</sup>  |  |                                     |
| According to International Patent Classification (IPC) or to both National Classification and IPC  |  |                                     |
| Int.Cl. 5 F03G5/08 ; H02K7/18  |  |                                     |
| <b>II. FIELDS SEARCHED</b>   |  |                                     |
| Minimum Documentation Searched <sup>7</sup>  |  |                                     |
| Classification System  | Classification Symbols   |                                     |
| Int.Cl. 5  | F03G ; H02K  |                                     |
| Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>   |  |                                     |
| <b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>  |  |                                     |
| Category <sup>9</sup>  | Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>                                   | Relevant to Claim No. <sup>13</sup> |
| Y  | FR,A,911414 (DELMAS) 08 July 1946<br>see page 1, lines 1 - 36; figures 1-4   | 1                                   |
| A  | ---  | 2, 4                                |
| Y  | US,A,2084612 (ENGELHEART) 22 June 1937<br>see column 1, lines 1 - 9<br>see column 1, line 37 - column 2, line 2; figure 1                        | 1                                   |
| A  | ---  | 2                                   |
| A  | DE,C,37510 (TIETZ) 07 February 1886<br>see page 1, lines 1 - 19; figures 1-6   | 1-3                                 |
| A  | PATENT ABSTRACTS OF JAPAN<br>vol. 7, no. 222 (E-201)(1367) 04 October 1983,<br>& JP-A-58 112438 (EIICHI) 04 July 1983,<br>see the whole document | 5                                   |
| <p><sup>9</sup> Special categories of cited documents : <sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p> |  |                                     |
| <b>IV. CERTIFICATION</b>   |  |                                     |
| Date of the Actual Completion of the International Search  | Date of Mailing of this International Search Report  |                                     |
| 07 AUGUST 1990   | 17. 08. 90   |                                     |
| International Searching Authority  | Signature of Authorized Officer  |                                     |
| EUROPEAN PATENT OFFICE   | LEFEBVRE L.J.F.   |                                     |

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**ANNEX TO THE INTERNATIONAL SEARCH REPORT  
ON INTERNATIONAL PATENT APPLICATION NO.**

PCT/OA 89/00001

SA 32968

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The members are as contained in the European Patent Office EDP file on

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| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|---------------------|----------------------------|---------------------|
| FR-A-911414                               |                     | None                       |                     |
| US-A-2084612                              |                     | None                       |                     |
| DE-C-37510                                |                     | None                       |                     |

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82